Title: Correlation of Human Olfactory Responses to Airborne Concentrations of Malodorous Volatile Organic Compounds Emitted from Swine Effluent

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Interpretive Summary:

Swine production facilities represent a major source of odor nuisance complaints due to the emission of odorant compounds, including volatile organic compounds, hydrogen sulfide, and ammonia. The emission of these compounds has been shown to adversely impact air quality in the vicinity of these facilities and has been linked to physical and psychological dysfunction in residents near these facilities. Measurement of agricultural waste odor has remained a low throughput, highly subjective process due to its dependence on the human olfactory system. Zahn et al. now show that gas chromatography coupled with odorant intensity modeling can be applied to accurately measure perceived odor intensity associated with swine odor. Results show that direct chemical analysis of indicator odorants present in air samples can be used as an alternative to olfactory measurements for evaluation of best management practices or for identifying farms that may represent a potential odor nuisance risk. The results of this study are important to the entire U.S. swine industry, including individual swine producers and commodity organizations (National Pork Producers Council) serving the interests of individual pork producers, because the methods permit a rapid, objective quantification of odor intensity associated with a swine production facility. The results and methods described in this study also represent important tools for scientists (industry, government, and academia) in the development and evaluation new odor remediation strategies, and for regulatory agencies (State and Federal) that are charged with investigating nuisance complaints near swine production facilities.

Technical Summary:

Direct multicomponent analysis of malodorous volatile organic compounds (VOCs) present in ambient air samples from 29 swine production facilities were used to develop a 19 component artificial swine odor solution that simulated olfactory properties of swine effluent. Analyses employing either a human panel consisting of 14 subjects or gas chromatography were performed on the air stream from an emission chamber to assess human olfactory responses or odorant concentration, respectively. Analysis of the olfactory responses using Fisher's LSD statistics showed that the subjects were sensitive to changes in air concentration of the VOC standard across dilutions differing by approximately 16%. The effect of chemical synergisms and antagonisms on human olfactory response magnitudes was assessed by altering the individual concentration of 9 compounds in artificial swine odor over a 2-fold concentration range while maintaining the other 18 components at a constant concentration. A synergistic olfactory response was observed when the air concentration of acetic acid was increased relative to the concentration of other VOC odorants in the standard. An antagonistic olfactory response was observed when the air concentration of 4-ethyl phenol was increased relative to the other VOC odorants in the standard. The collective odorant responses for 9 major VOCs associated with swine odor were utilized to develop an olfactory prediction model to estimate human

odor response magnitudes to swine manure odorants through measured air concentrations of indicator VOCs. The results of this study show that direct multicomponent analysis of VOCs emitted from swine effluent can be applied towards estimating perceived odor intensity.